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### ② Transaction system.

② A cashless transaction system, in particular for paying for fuel at a petrol station, includes a key fob (1), issued to the driver of a vehicle and containing a processor, memory and input/output means; and a complementary read/write unit (13) at the station, the fob acting as a credit card, debit card or pre-payment card to pay for fuel received. Data is transferred by contactless coupling between the fob and read/write unit.

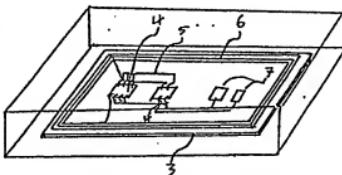


FIG 2.

## Description

## Transaction System

This invention relates to an electronic system and in particular but not exclusively it relates to a system for paying for fuel such as petrol or diesel fuel at a petrol station forecourt by a means other than cash.

When a vehicle user wishes to buy fuel for his vehicle the procedure generally followed is that he will drive into a petrol forecourt, fill his tank with a desired quantity of petrol or other fuel and go to a cash desk to pay for the fuel, either by means of cash, cheque or credit card. Although the idea of using a credit or debit card in such circumstances is well known, the user can only make use of this facility if he remembered to bring his appropriate card with him. Furthermore, the range of credit or debit cards accepted by any particular fuel sales outlet may vary and it can be most frustrating to find, after filling a petrol tank, that the user does not possess the relevant card or enough cash to pay for the fuel. In addition, conventional credit cards are open to fraudulent use.

The present invention arose in an attempt to obtain a more convenient method of paying for the fuel and also in an attempt to provide a yet more secure system than a credit card or cash.

According to the present invention there is provided a transaction system including a portable tag forming a key fob or part of a key and including processing means, memory means and a and inductive input/output means, and a read/write unit at a point of sale arranged to couple inductively with the tag for cashless payment for goods and/or services, wherein the tag and each read/write unit are provided with cooperating means for establishing authorisation between the tag and read/write means and for forbidding a transaction if authorisation is not established.

For ease of use, the tag and read/write unit couple in a contactless manner, such as that disclosed in GB 2173623A.

Motor vehicles generally require the use of one or more keys; firstly to obtain entrance to a vehicle and secondly for actuating the ignition system of a vehicle. Locks and keys are also commonly used on petrol caps to aid security. In apparatus according to the present invention a tag of the type described is linked to such a key and thus, it can be assumed that whenever the user has his car keys with him, i.e. whenever the car is being used, he also has the tag. Preferably therefore the token is in the form of a key fob. Alternatively, the token could be integral with a key.

Preferably, in order to improve the security of such a system, the tag and each read/write unit are provided with complementary means for establishing authorisation between the tag and read/write means and for forbidding a transaction if authorisation is not established. The tag may have a unique identifier, such as a PIN (Personal Identification Number) stored within it and the read/write unit be provided with a means, such as a keypad, with which a user can enter his PIN. If the two identifiers agree

then authorisation can be established. An expiry date may also be included within the tag, which date can be checked.

- 5 The tag may be a prepayment one, in which a plurality of units may be "bought" and loaded into the tag, which could be replenishable, or the card could be of the debit type and generate an "electronic cheque" as is described further below. In the latter case, the read/write unit is preferably linked to a remote computer containing details of a user's account and means are provided for debiting or crediting the users account in accordance with the value of a transaction, either as the transaction is made or at a later time.

In one embodiment the system is used for paying for fuel and the read/write unit is connected to means for measuring the amount of fuel used and for calculating the value of a transaction. The read/write unit may be connected to a fuel actuator such as a pump and thus enable fuel to be dispensed only if correct authorisation is established. Advantageously, the actuator could be shut off if operative contact between the tag and read/write unit is broken. A delay may be included so that accidental removal and replacement of the tag does not terminate dispensing but a deliberate removal does.

In a second aspect of the present invention there is provided a read/write unit for interacting inductively with a portable token of the type comprising processing means, memory means and input/output means, the unit comprising a surface shaped to receive a token and at least one inductive loop disposed such that it encircles the surface and lies outwardly of or level with that surface.

Preferably the surface is a recess and the loop is embedded in the unit and encircles the recess.

Embodiments of the invention will now be described by way of example only with reference to the accompanying drawings in which:-

Fig. 1 shows payment apparatus including a portable tag;

Fig. 2 shows schematically a tag in more detail;

Fig. 3 shows schematically a cashless payment system according to the present invention;

Fig. 4 shows a schematic control system; and

Figs. 5 & 6 show variations of read/write units.

Referring to Figure 1, in a cashless payment system according to the present invention a user is provided with a portable token in the form of a small tag forming a key fob 1. This will be attached to one or more keys 2 which serve to operate the ignition of a vehicle, which may be any type of motor vehicle, and/or to effect entry to that vehicle or to gain access to its fuel filling system. A mechanical key is shown but the key may of course be one which is operated electronically, by infra-red, or by any other means.

Figure 2 shows in more detail the typical structure

of key fob 1. Embedded within the fob is a print circuit board or substrate 3 upon which is mounted one or more integrated circuits 4 and interconnections 5 between these. The circuits are connected to an inductive loop 6 also mounted on the printed circuit board which serves to communicate information into and out of the fob by inductive coupling with an external coupler described in more detail below. Conveniently, such inductive coupling may be achieved by means of a system as is disclosed in GB 2173623A.

The token or fob may be manufactured in any convenient manner and it has been found useful to manufacture it by means of a moulding process such as by reaction injection moulding. Typically an epoxy or a polyurethane may be used for this. The PCB 3 is held in a mould by means of a plurality of pegs (not shown) made of the same material as the moulding plastics material and the plastics material is then poured into the mould and set, thus holding the circuit board securely in place. The pegs need not of course be the same material as the moulding material but it is useful for them so to be. Further components 7 are shown on the figure and may be required in some circumstances. These could be for instance capacitors or inductors.

Figure 3 shows one arrangement in which a cashless payment system may be organised. At a fuel supply station such as a petrol station forecourt a plurality of pumps 8 are provided. These will for convenience be termed petrol pumps but they could equally well be for diesel fuel or any other type of liquid fuel. Generally all such pumps are linked by means of a control line 9 to a central controller 10, which is most often held within a central payment area shown generally at 11. The controller generates signals to actuate each pump and measures the amount of fuel used at each pump during each transaction. This information is supplied to an EPOS (Electronic Point of Sale) unit 12 and the customer is billed according to the charge shown on the till.

Credit cards may also be used for payment in most instances and a separate credit card "swipe" unit (not shown) may also be connected to the EPOS unit 12, which unit reads details held within the magnetic stripe present on every credit card or charge card and allows bills to be made out to that particular customer. In the system of the invention two further units 13 and 14 are also connected to the EPOS unit 12. Unit 13 is a read/write unit which is preferably of the type described in the aforementioned UK patent application GB 2173623A and include an inductive loop 15 mounted near one surface thereof such that when a customer places a set of keys, including fob 1, upon the read/write unit operative coupling may be achieved between inductive loops 6 and 15, on the fob and read/write unit respectively. Read/write unit 13 may have an on board processing capability or may be used merely to send control signals to EPOS unit 12 which will include processing ability. A key pad 14 is also connected to the EPOS unit. In some embodiments of the invention the EPOS unit 12 is a local controller and is connected or connectable to one or more remote computers 16, such as bank or credit card

companies computers. These computers hold details of customers accounts and such embodiments of the invention will be described in more detail below.

- 5 Assuming now that the EPOS unit 12 is not connected to a remote computer, the user of the system first takes his vehicle to one of the plurality of pumps 8 and fills his fuel tank with a desired amount of liquid fuel. The user subsequently takes his key-ring, including the "intelligent" fob 1 to the payment area 11 and places the keys on the reader 13 in such a manner that operative coupling is achieved between fob 1 and coil 15. It is important firstly to establish that the user of the fob is the correctly authorised user. Authorisation techniques are well known and similar techniques may be used to those which have been developed for so called "smart cards". One such method is described in UK Patent Application No. 8711743.
- 10 In a simple version, the token may contain, electronically stored within it, a so called PIN (personal identification number) which is unique to the particular user. The user is asked to enter at keypad 14 his PIN number. The number entered by the user is then sent via the EPOS unit to the tag or fob which compares it with an internally stored number held in a secure part of memory. If both agree the tag will allow the transaction to proceed. If authorisation is not established then the user is not allowed to conduct a transaction. Further methods of authentication including finger print or voice data could also be used for further security. The fob can further include an expiry date which can be checked by the system and authorisation refused if that date has been passed.
- 15 Once authorisation has been established then a transaction is allowed to take place. This could take place in two ways, firstly the fob can be used as a prepayment card and includes a number of monetary units which are decremented in accordance with the value of purchases. Alternatively the tag can issue an electronic cheque.
- 20 In the former method, the tag is preferably adapted such that at any time it can be loaded with a number of prepaid units which serve as monetary units. These units could be purchased at for instance bank or petrol stations and are loaded on by means of a computer in known manner. When a transaction is conducted, the EPOS unit 12 serves, with the reader 13, to debit a number of units from the token dependent upon the amount of fuel used and its value. The amount of fuel used and its value are fed to the controller 10 on line 9 from the pump and the charge is determined. Provided there are enough units remaining on the card at the beginning of the transaction to pay for the fuel used, units are deducted from the card. If the card becomes totally or partially uncharged, i.e. no units or less than a minimum threshold number of units are remaining, before the whole value of the transaction is deducted, then the transaction can be stopped and warning actuated, in which case the card should be recharged.
- 25 When the system is used as an electronic cheque type payment system the fob need not be of the type
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which can be pre-loaded with monetary units and can instead, once authorisation has been established, issue a command to EPOS unit 12 which is in the form of an electronic cheque and which is ultimately fed to a computer holding the user's bank, credit card or other charge account. This could be done by using a remote link, as shown at 16, either in an on-line or off-line mode. For the off-line case the message can be passed at a later time of day when perhaps the lines are not so busy. Alternatively a permanent or semi-permanent record such as a paper document or perhaps a magnetic disk or tape could be made of the transaction and this could be forwarded to the relevant bank etc. for the client's account to be debited. A combination of both the pre-payment and electronic cheque systems can be applied to a single card. For example, the user could use the card to issue an electronic cheque command to pay for a number of prepaid monetary units which are then applied to the same card. The card can then continue to be used for paying for, e.g. fuel according to the number of units credited to it, as described hereinbefore.

Credits could also be made with such a system where these are necessary and credits could also be applied directly to the card.

There is no necessity that the reader 13 be located at a central payment office and indeed a reader may be provided at each pump location 8.

Figure 4 shows schematically how a control system might work. In which a reader is located locally at the pump, although this control is also applicable if the reader is located at a central location. The reader in this case is connected directly to a fuel actuator means 24 which serves to actuate the pumping of fuel from the dispenser. The system is then arranged such that the actuator 24 is not permitted to function until authorisation has been achieved by, for example, comparing a user's entered PIN number with that stored upon the fob. The system may also check, if the fob is one which stores a plurality of units which are decremented as they are used up, that a sufficient minimum number of units remain on the card. If not, then authorisation is not obtained. Once authorisation is obtained, the fuel actuator is switched on and fuel is allowed to be dispensed from a pump nozzle 18. The amount of fuel dispensed is measured by a fuel meter 16 and applied to a unit shown as a calculation unit 17 to which the current price for that particular fuel is applied. Unit 17 then calculates the value of the transaction. This value is then applied from the calculation unit 17 to reader 13 and thence to token 1 to perform a monetary transaction in any of the ways described above.

A further requirement of this system could be that if the fob is removed from operative contact with the reader for any reason the actuator is instructed to stop pumping, in which case the fuel supply is cut off to the dispenser. A delay could be included here of chosen time period to allow for the fob accidentally being knocked off the reader and replaced.

The simplest type of reader is one which comprises an inductive loop mount 14 undernot a flat surface on which the fob can be placed directly. It

may be more advantageous to use an alternative form of inductive reader, two examples of which are shown in respective Figures 5 and 6. In Figure 5 a reader is shown which includes a slot 19 for receiving the fob 1. An inductive field can be applied in any suitable manner to the slot, but a preferred way of achieving this is shown in Figure 5A in which a C core 20 is used to supply a magnetic field across an article placed within the slot. (An inductive coil 21 serves the function of the inductive loop 15 of Figure 3.) A ledge 22 is provided on such a reader such that other keys or items held on the same key-ring as fob 1 can be rested thereon and do not hang loose where they can possibly cause the fob to fall out by gravity or may be caught by passing objects.

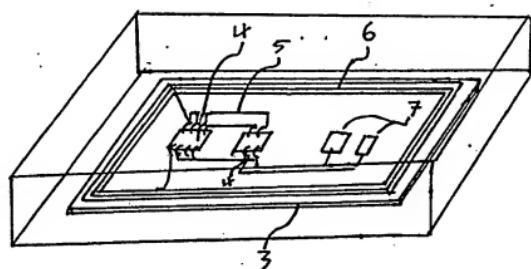
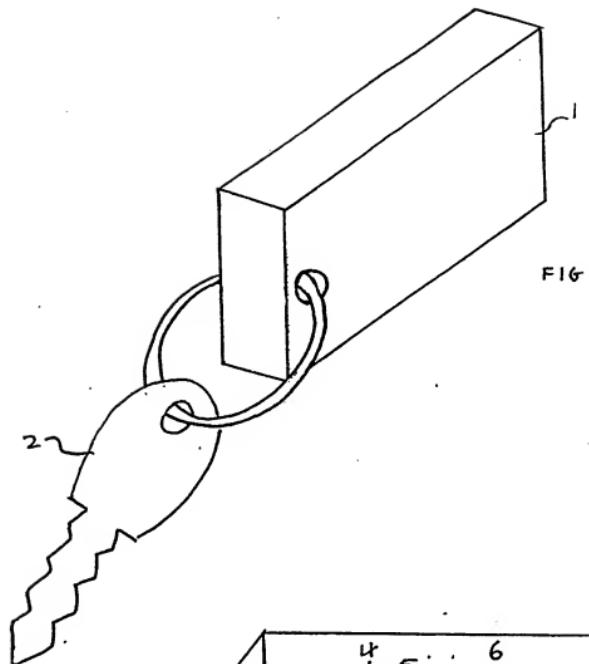
Figure 6 shows yet another and preferred type of reader in which the reader is provided with a recess 23 in its top surface. Figure 6A is a section through X-X of Fig. 6A and shows in more detail this recess. In this case the inductive loop 6 is disposed around the recess such that the recess extends down to or below the plane of the loop or loops. Thus the tag or fob 1 can be received with greater accuracy and also a greater operating range at which the fob can communicate with the reader is achieved, since the fob can now lie either a certain distance under the plane of the coil or that certain distance above it. Previously it could only lie at certain distance above. The recess can be, as shown in the drawing, significantly larger than the fob or could be of similar and complementary dimensions to the fob such that the fob can fit securely in the recess and any keys sit outside the recess. As an alternative, the inductive loop may be provided on a raised ridge above a substantially flat reader surface and thus the recess will be formed by the portion of the reader surface in between the raised ridge holding the loop.

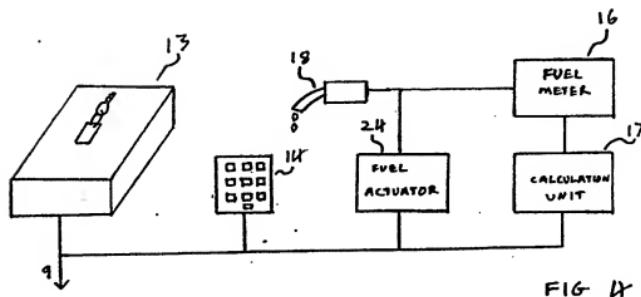
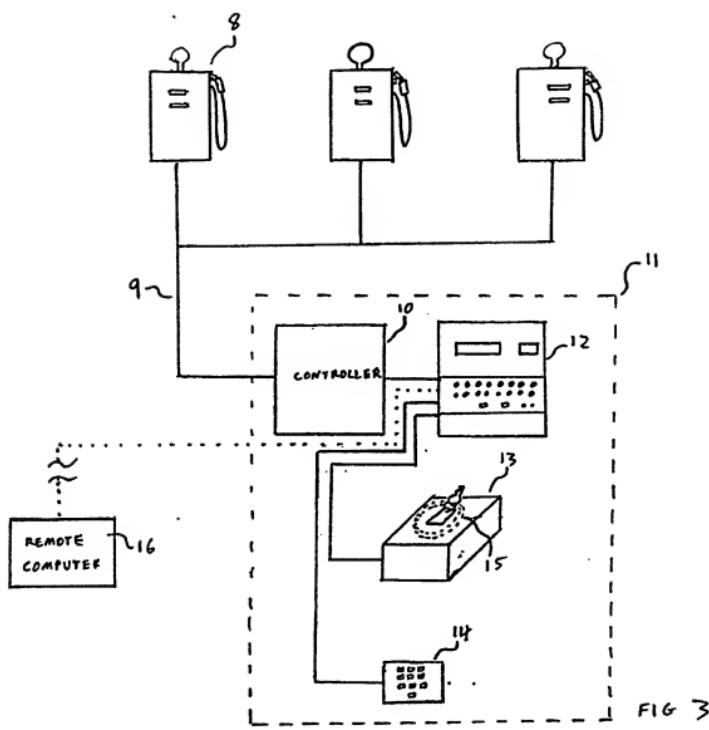
Although the intelligent token has been described as being a key fob and forming a separate item to an actual ignition or car entry key, it is envisaged that the token could form part of the key itself and could perhaps form the handle portion of the key, which portion is not inserted into a lock. The key itself could be an electronic key in which case the functions for operating the ignition system of a vehicle and effecting entry to the vehicle may or may not be integral with the cashless payment electronic system. The token may of course be appropriate for payment for other types of goods other than fuel and even for payment for services. Furthermore, by altering the relevant parts of "hole in the wall" cash dispensing machines a token could be used as a cash dispensing card. This application will be most convenient since a car or other vehicle user tends to carry his keys with him at most times and thus, if the need for cash suddenly arises, he is more likely to have his car keys with him than a wallet or purse containing a conventional credit card or "smart card".

Similarly, for the above reasons, it may be useful to configure a person's credit card, debit card or prepayment card in the form of a key fob, in which case read/write units are suitably placed in shops or other sales outlets and used to charge the customer.

## Claims

1. A transaction system including a portable tag forming a key fob or part of a key and including processing means, memory means and inductive input/output means, and a read/write unit at a point of sale arranged to couple inductively with the tag for cashless payment for goods and/or services, wherein the tag and each read/write unit are provided with cooperating means for establishing authorisation between the tag and read/write means for forbidding a transaction if authorisation is not established.
2. A transaction system as claimed in claim 1, wherein the tag is adapted to be loaded with an identifier code, unique to its user or class of user, and the system includes means for a user to input an identifier code and means to compare the identification code loaded on the tag with that input by the user and to establish authorisation only if the codes are identical.
3. A transaction system as claimed in claim 1 or claim 2, wherein the tag is a prepayment tag and is adapted to be loaded or is preloaded with a plurality of units representing monetary values and the units are arranged to be decremented in accordance with the value of goods and/or services purchased.
4. A transaction system as claimed in claim 3, wherein the units are replenishable.
5. A transaction system as claimed in Claim 1 or 2, wherein the tag is arranged to generate an "electronic cheque" as part of the transaction.
6. A transaction system as claimed in claim 5 wherein the read/write unit is linked to a remote computer containing details of a user's account and means are provided for debiting or crediting the user's account in accordance with the value of a transaction, whether as the transaction is made or at a later time.
7. A transaction system as claimed in any one of the preceding claims, adapted for payment for liquid fuel at a fuel service station, wherein the read/write unit is connected to means for measuring the amount of fuel used and for calculating the value of a transaction.
8. A transaction system as claimed in claim 7 wherein the read/write unit is further connected to a fuel actuator and enables fuel to be dispensed only if correct authorisation is established.
9. A transaction system as claimed in Claim 8, wherein fuel dispensing is terminated if operative coupling between the tag and read/write unit is broken.
10. A transaction system as claimed in claim 9, wherein dispensing is terminated only if a predetermined time period has elapsed without operative coupling being re-established.
11. A transaction system as claimed in claims 8 to 10, wherein the tag is of the prepayment type and the system is adapted such that fuel dispensing is terminated if the number of units remaining on the tag, falls below a predetermined threshold value.
12. A key fob adapted for use in a transaction system as claimed in any one of the preceding claims.
13. A read/write unit for interacting inductively with a portable token of the type comprising processing means, memory means and input/output means, the unit comprising a surface shaped to receive a token and at least one inductive loop disposed such that it encircles the surface and lies outwardly of or level with that surface.
14. A read/write unit as claimed in claim 13 wherein the surface is a recess and the loop is embedded in the unit and encircles the recess.





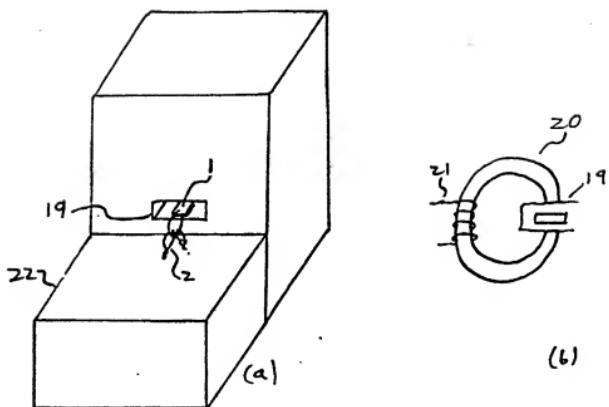


FIG. 5

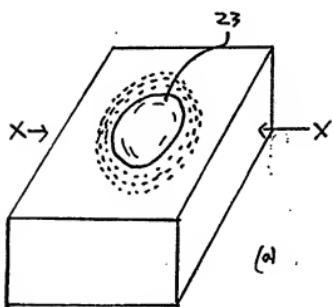


FIG. 6